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BUREAU OF ENTOMOLOGY

FOREST INSECT INVESTIGATIONS

PRELIMINARY REPORT CONCERNING THE RELATIONSHIP BETWEEN MOUNTAIN PINE BEETLE INFESTATIONS AND TYPES OF HOST MATERIALS

1936 Investigations

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Forest Insect Laboratory
Coeur d'Alene, Idaho
Mar. 26, 1938

Dr. F. C. Craighead
Washington
D. C.

Dear Dr. Craighead:

There are enclosed two copies of a laboratory report by Mr. Bedard, "Preliminary Report Concerning the Relationship between Mountain Pine Beetle Infestations and Types of Host Materials". This was prepared in accordance with a plan to subdivide the report of the infestation study into smaller papers, as it was believed best to follow such a procedure. The report is based upon two years' data, and though the trends are given for what they may be worth, it is realized that a great deal more information is needed representing different seasons, environmental conditions, and so forth, before conclusions can be drawn.

In this report it is interesting to note that logging slash, including cull logs and road slash, is not as important as we have been lead to believe in the past. However, as stated, additional work may materially change the appearance of the data presented.

Your comments, criticisms, or suggestions are earnestly solicited. Reports of other phases of this study will follow within the next few weeks.

Respectfully yours,

James C. Evenden
Senior Entomologist

Enclosures

cc to:
Mr. Miller
Mr. Keen
Mr. Beal

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PRELIMINARY REPORT CONCERNING THE RELATIONSHIP BETWEEN MOUNTAIN PINE BEETLE INFESTATIONS AND TYPES OF HOST MATERIAL

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Introduction

It is known that the mountain pine beetle attacks several different types of western white pine host material. At times during the course of an infestation one or the other of these types is so abundant that it represents a dominant factor which must be evaluated in order to determine the importance of the outbreak. This has been particularly difficult because the mountain pine beetle brood produced per square foot of bark in different types of decadent host material as compared with standing trees has never been properly determined. The question is a particularly important one at this time, because of the interest that is being taken in the matter of slash disposal. Both the Western Pine Association and the local section of the Society of American Foresters have recently appointed committees to study this subject.

During the past season practically all of the different types of host material were examined by the infestation study crew on the Coeur d'Alene National Forest. All material was examined by taking a half-square-foot sample on four sides of the tree at ten-foot intervals and recording the number of mountain pine beetle broods, parent emergence holes, attacks, inches of egg gallery, parasites, predators, wood borers, square inches of secondary bark-beetle work, woodborer

work and woodpecker work.

In this report five types of host material have been recognized, namely, road slash and cull logs, logging slash and cull logs, windfalls and physically injured trees, burned trees and standing trees weakened by disease. Each of these types will be considered separately.

Road Slash

In the areas examined by the infestation study crew all white pine trees felled in the process of road construction were cut into logs and sold. This left only tops and cull logs along most new roads, and during 1936 left no material at all which was suitable for examination. Table I shows conditions in both 1935 and 1936 road slash. The 1935 material was attacked during 1935 and examined at the time of emergence in 1936. The 1936 material was attacked and examined during 1936, and as these logs were removed following their examination, only two culls were available for study at the time of emergence during 1937.

Table I

Conditions in Road Slash

Year of attack	Year of examination	Bark surface	Average per square foot of bark					
			Brood	Attacks	Parasites	Predators	Secondary work	Cerambycid work
		Sq. ft.	No.	No.	No.	No.	Sq. in.	Sq. in.
1935	1936	2,567	.7	.6	.6	3.2	79	.6
1936	1936	2,110	56.1	1.5	.7	1.2	12.3	3.7
1936	1937	124	1.2	1.6	.4	.9	81.2	8.4

Table I shows that there was a negligible amount of emergence from the 1935 material, and indications are that there would have been but a slight emergence from the 1936 material in spite of the rather high potential apparent in the early developmental stages. The cause of this high mortality in road slash is not exactly known. It is apparent, however, that secondary bark beetles, particularly Ips vancouveri and Pityogenes fossifrons, and woodborers, destroy a large part of the available bark surface. In addition to the broods destroyed by robbers, parasites, and predators there undoubtedly is some mortality in this material resulting from overheating during the summer.

From available data shown in table I the indications are that road slash is given over mostly to secondary bark beetles and woodborers and does not threaten as a potential source of mountain pine beetles, nor does it serve as a source of beneficial insects.

Logging Slash

The logging slash examined in this study comprised tops, cull logs, and stumps. The area examined in 1936 was an experimental clear-cutting area in which the slash was scattered. In 1937 another experimental area was used, in which a heavy residual stand was left and the slash was piled and burned. These two areas represent the approximate extremes in shade following the logging of a white pine stand. Table II shows the data from these two examinations.

Table II

Conditions in Logging Slash

Year of attack	Year of examination	Average per square foot of bark: Bark surface	Brood	Attacks	Parasites	Predators	Secondary work	Cerambycid work
		Sq.ft.	No.	No.	No.	No.	Sq.in.	Sq.in.
1935	1936	1,210	.1	.08	.09	.04	1.4	.06
1937	1937	3,444	2.8	.2	.2	.6	34.2	.06

The data shown in table II indicate quite clearly that logging debris is decidedly unfavorable for the development of the mountain pine beetle. The material examined during 1936 was unshaded, and was apparently unfavorable for secondary bark beetles and woodborers as well. The shaded material examined in 1937, however, did produce a quantity of secondary bark beetles. The mountain pine beetle broods contained in this material are negligible owing to the fact that they have yet to overwinter, during which time considerable additional mortality will occur.

Windfalls and Physically Injured Trees

The first two classes of host material represent that type which is subject to rapid drying owing to the fact that it has been severed from the roots. Windfalls, lightning-struck trees, other physically injured trees, trees scorched by fire, and trees weakened by disease represent another class in which the trees maintain a full or partial root system for some time and thus provide some moisture to the developing broods. As there are differences in these various types, this class has been divided into three groups, namely, windfalls and physically

injured trees, fire-scorched trees, and trees weakened by disease. Table III shows the data secured from windfalls and broken-topped trees. During the past two years there has been a scarcity of material of this nature on the Coeur d'Alene Forest, so that for the purpose of securing a better average the trees from both seasons' work have been grouped.

Table III

Comparison of Windfalls and Broken-Topped Trees with Standing Trees

Type of material	Trees	Bark surface	Average per square foot of bark: Brood	Attacks	Parasites	Predators	Secondary work	Ceram-bycid work	Woodpecker work
	No.	Sq.ft.	No.	No.	No.	No.	Sq.in.	Sq.in	Sq.in.
Weakened trees	10	2,078	25.4	2.1	3.8	4.3	35.2	1.9	10.6
Standing trees	166	30,000	32.9	6.1	3.3	1.5	12.7	2.3	2.5

Table III bears out the belief that broods in windfalls are almost as abundant as those in standing trees even though there are nearly three times as many attacks in the standing trees as in the windfalls, and parasites, predators, and robbers are decidedly more abundant in the windfalls. It is obvious, therefore, that this type of host material is an important factor in infestations of the mountain pine beetle. With few attacks, this insect can produce almost as abundant progeny in windfalls as nearly three times the number of attacks in standing trees.

It might be thought that the equality of the brood in spite of the difference in attack is due to the fact that less parent emergence

occurs in the windfall material because of less competition for bark surface. There is, however, a proportionate emergence of parent beetles from both types of material. In the windfalls parent emergence holes were 63 percent of the attacks, while in standing trees they were 57 percent of the attacks.

Relative to egg gallery construction, there were 35.7 lineal inches in windfall material and 78.0 inches in standing trees. Dividing this by the number of attacks, there were 17.4 inches per gallery in windfalls and 12.9 inches per gallery in standing trees.

Fire-Scorched Trees

Only one small burned area was available to this study during the past season, in which a total of seventeen scorched trees were felled and examined. These trees had been left on top of a low ridge to regenerate surrounding areas which had been clear cut and burned broadcast. Table IV shows the data from these seventeen trees.

Table IV

Conditions in Fire-Scorched Timber

Year of attack	Year of examination	Bark surface	Average per square foot of bark: Brood	Attacks	Parasites	Predators	Secondary work	Cerambycid work	Woodpecker work
			No.	No.	No.	No.	Sq.in.	Sq.in.	Sq.in.
1936	1937	3.291	.01	.3	.01	1	42.8	.9	0

Table IV shows that the trees in this particular area were of

no great importance as potential sources of mountain pine beetle infestation. This does not necessarily indicate that all fire-scorched white pine trees produce such meager broods. Additional data of a similar nature representative of other types of burned areas are necessary before conclusions can be made.

Trees Weakened by Disease

This class comprises for the most part those trees which have been damaged by root fungi, thought to be primarily one fungus, Armillaria mellea. Unfortunately, owing to the type of damage which is the habit of this fungus, it is sometimes impossible to ascertain the presence of the disease without exposing a large portion of the root system. Even then, it is impossible to make a comparative evaluation of the injury because of the difference in the progressive stages of development of the rot. Under these circumstances it is difficult to say whether these trees fall in the class with slash and cull logs, the class with windfalls and physically injured trees, or whether they represent a third class. Whatever the class, there is undoubtedly a wide variety of conditions represented by these trees varying from those in which one side has been killed to those in which the presence of the fungus can be found only after digging well out along the lateral roots. One thing is certain, however, that they do represent a low-resistance class, the value of which has not yet been determined.

There is apparently a slight preference by the mountain pine beetle for these diseased trees. Out of a total of 76 green trees

examined 10, or 13.1 percent, were infected with root rot, while a total of 99 mountain-pine-beetle-killed trees showed 36, or 36.4 percent, infection. It is logical to assume that were no preference shown by the beetle, the diseased beetle-killed trees would be in the same percentage as in the green stand. It is, however, difficult to determine the presence of the fungus in green trees without injuring the tree to some extent, so that the percentage of infection in green timber might be higher than indicated by the above figure.

Tables V and VI show the incidence of the diseased trees according to site and site moisture.

Table V

Incidence of Diseased Trees According to Site

Site	Trees examined	Trees infected	Trees uninfected	Percent infected
	No.	No.	No.	
1	11	2	9	18.2
2	33	12	21	36.4
3	35	13	22	37.1
4	4	2	2	50

Table VI

Incidence of Diseased Trees According to Site Moisture

Site moisture	Trees examined	Trees infected	Trees uninfected	Percent infected
	No.	No.	No.	
Wet	18	4	14	22.2
Medium	21	6	15	28.6
Dry	60	26	34	43.3

Tables V and VI indicate that trees infected with root rots are found more commonly on the drier, poor sites. These tables also raise the question as to whether root rots are a primary organism or whether they are dependent upon a decadent condition or some other factor which lowers tree resistance.

Table VII shows the status of mountain pine beetle broods in diseased trees as compared with uninfected timber.

Table VII

Diseased Trees Compared with Uninfected Trees

Type of material	Year of attack	Year of examination	Trees examined	Bark surface	Average per square foot of bark: Brood	Attacks	Parasites	Predators	Secondary work	Cerambycid work	Woodpecker work
			No.	Sq.ft.	No.	No.	No.	No.	Sq.in.	Sq.in.	Sq.in.
Diseased	1936	1937	38	7,512	26.7	2.3	2.3	1.2	23	3.2	2.4
Sound	1936	1937	68	12,433	46.2	3.9	4.4	1.5	9.2	3.5	6.9
Diseased	1937	1937	48	6,981	63.9	2.0	1.9	.9	15.9	1.8	.01
Sound	1937	1937	83	13,992	62.6	1.7	2.7	1.3	22.6	2.3	.01
Diseased	Total		86	14,493	46.0	2.2	2.2	1.1	19.6	2.5	1.3
Sound	Total		151	26,425	54.9	2.8	3.5	1.4	16.3	2.8	3.3

It is difficult to ascertain from table VII the status of the diseased trees. All "dry sides", which are common in diseased trees and which are unproductive of mountain pine beetle broods, have been eliminated. In spite of this and lower parasitization, however, the diseased trees produced less brood in 1937 than comparative uninfected trees. The trees attacked in 1937, however, show approximately the same potential. These data indicate that diseased trees are attacked with approximately the same intensity as uninfected trees and are capable of producing approximately the same volume of new beetles per square foot. During 1937, however, the diseased trees produced but slightly more than half the brood that emerged from the uninfected trees. The important fact remains, however, that attacks during 1936 and 1937 were at minimum intensity. Although such a small number of attacks per square foot may be usual in diseased trees, attacks in uninfected trees average considerably more, so that under normal circumstances it is possible that diseased trees are less intensely attacked than undiseased material. It is also obvious that the diseased trees are capable of producing abundant broods and, as they succumb readily to attacks of the beetle, undoubtedly serve to maintain the infestation at a high normal level.

Attraction of Host Materials

Unfortunately, no data are available relative to the importance of any of these host materials in attracting beetles to adjacent green stands. Information of this nature is necessary in order to present a true picture of the importance of any of these materials.

SUMMARY

Several different types of host material are attacked by the mountain pine beetle. Thus in order to determine the importance of any infestation it is necessary to make a proper evaluation of the various host materials.

Present indications are that road slash and cull logs, although potentially capable of abundant broods, do not threaten as a potential source of mountain pine beetles. The available bark surface is utilized mostly by secondary bark beetles and woodborers.

Available data indicate that logging debris is unfavorable for the development of the mountain pine beetle. This host material is quite similar to road slash in producing abundant broods of secondary bark beetles.

Data secured during the past three years indicate that mountain pine beetle broods in windfalls are almost as abundant as those in standing trees even though there are nearly three times as many attacks in standing trees. Parasites, predators, and robbers are decidedly more abundant in windfalls. This type of host material is an important factor therefore in infestations of the mountain pine beetle.

In the one small burned area examined, the data indicate that the trees in this particular area were of no great importance as potential sources of mountain pine beetle infestation.

Trees infected with root rots appear to be slightly preferred by the mountain pine beetle over uninfested trees. The diseased trees

are found mainly on drier, poorer sites, and are attacked with approximately the same intensity as uninfected trees and are capable of producing approximately the same volume of new beetles per square foot.

No data are available concerning the attraction of these various types of material and the resultant infestation in adjacent timber.

Respectfully submitted,

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Assoc. Entomologist